Technical Note

TN 5.18 Lining of Casings with SaniTite® HP Pipe

In sanitary sewer, it is often necessary to use trenchless technology methods to install a casing pipe under high volume roads, railroads or other sensitive areas where the ground surface cannot be disturbed. Methods of installing the casing pipe will vary based on the native soil conditions, groundwater location, length of installation and the precision required for the pipe line and grade. SaniTite HP is not designed to withstand the high compressive or tensile forces associated with trenchless placement; however SaniTite HP pipe can be used as a carrier pipe within a casing, provided open pits are used at each end of the tunnel operation to prevent bending of the pipe in place. When short sections of sanitary sewer require trenchless placement, commonly a smooth-walled steel pipe with protective coating is used as the casing pipe, with its wall thickness dependent on anticipated loading conditions as well as regional specifications. Common placement methods for steel casings include horizontal auger boring (HAB) or pipe jacking, but the casing placement method does not necessarily impact the carrier pipe installation, as long as adequate access is provided.

Sizing of the Casing Pipe

In some cases, the diameter of the casing pipe may be limited by the in-situ conditions, such as proximity to bedrock or the presence of weak native soils. Where in-situ conditions are not the limiting factor in casing sizing, the smallest possible diameter pipe is often desired and is contingent upon the carrier pipe's outside diameter, additional conduits, and support/bracing system required for the carrier pipes. Table 1 provides the maximum possible pipe outside diameter.

Table 1
Dimensions of HP Pipe Products

	Nominal Inside Diam. in (mm)	Max Outside Diam.* in (mm)		Nominal Inside Diam. in (mm)	Max Outside Diam.* in (mm)
Dual Wall	12 (300)	14.6 (371)	Triple Wall	30 (750)	35.7 (907)
	15 (375)	17.8 (452)		36 (900)	41.7 (1059)
	18 (450)	21.5 (546)		42 (1050)	47.5 (1207)
	24 (600)	28.2 (716)		48 (1200)	54.3 (1379)
	30 (750)	35.5 (902)		60 (1500)	67.2 (1707)

* Contact ADS for additional guidance if anticipated OD values provided may not provide adequate clearance.

To ensure consistent line and grade over the life of the sanitary sewer, the pipeline is braced in the casing to prevent movement. Bracing systems can range from field-installed skids banded to the exterior of the pipe to manufactured casing spacers installed incrementally along the carrier pipe. The bracing system and the diameter of the casing are dependent on each other, where a specific casing spacer type may require a larger clearance around the carrier pipe, or vice-versa where a casing pipe diameter may limit the type of bracing that can be used. Additional information on bracing systems and installation is the *Casing Spacers and Skids* section of this document. No matter what bracing system may be used, minimum 1-inch should be left between the inside of the casing and the outside of the bracing. This clearance helps prevent the pipe/spacer system from getting wedged in the casing due to warped casing pipe or imperfections caused during trenchless operations.

Structural Requirements

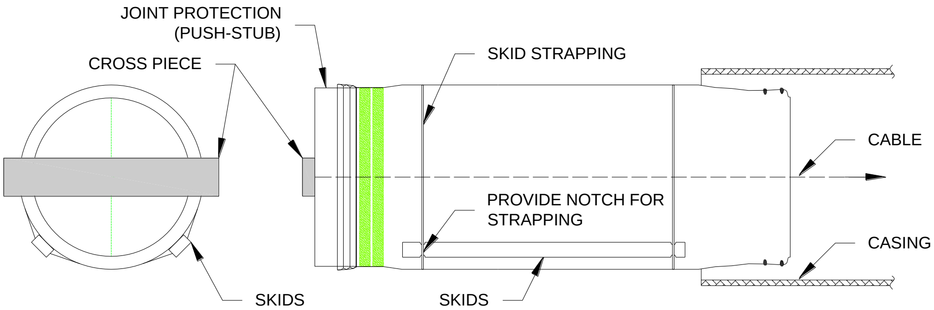
In the case of trenchless casing pipe installations, the casing pipe being installed is typically designed such that the live and dead loads are carried solely by the casing pipe with no load being transferred to the carrier pipe. For cases where a deteriorating pipe is being sliplined or the design requires a load to be carried by the sewer pipe within the casing, pipe suitability is often evaluated as if the casing pipe were not present and fill height and live loading recommendations are followed in the same manner as open-cut trench installations.

Installation Techniques

Often times the length of sewer section requiring a casing is less than 300ft when road or rail crossings are relatively narrow. For these circumstances, a typical method simply involves joining successive carrier pipe joints together outside of the casing while pushing the carrier pipe through the casing. It is recommended that a push stub or large blocking surface be used to push the pipe through the casing to avoid point loads damaging the pipe end.

A second method involves passing a cable through the casing and the first stick of pipe to pull the pipe in place. On the opposite end of the pipe a suitable cross piece is installed as well as protection for the pipe joint (push stub). The cable is pulled through the casing by a winch or other mechanical equipment thus bringing the carrier pipe inside the casing. Once a majority of the first pipe is inside the casing, the cross piece is disassembled and attached to the next pipe, joints are assembled and the operation begins again. See Figure 2 for an illustration of this method.

Figure 2
Pulling HP Pipe in Casing



Using casing spacers will help minimize the resistance between the two surfaces, possibly allowing for longer installations. Table 2 provides the maximum recommended thrust force on the joint. While push length values are provided for reference, specific installation conditions, including the casing pipe and spacer/blocking materials, will impact the allowable push length.

Table 2
Maximum Push Force on HP Products

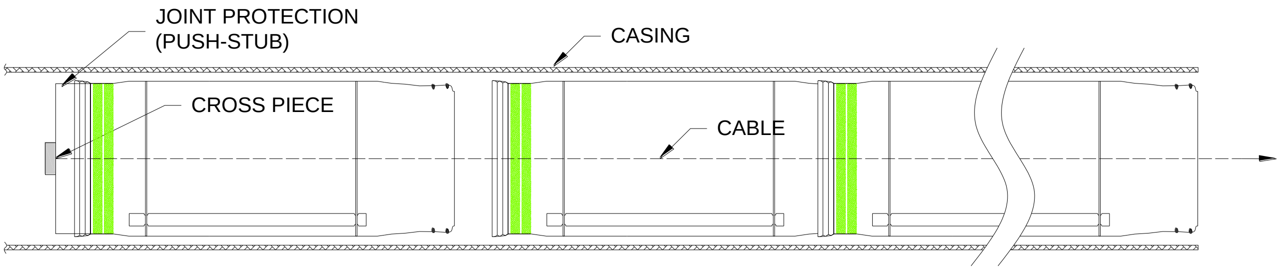
Nominal Inside Diam., in (mm)	Max Thrust Force, lbs (kN)	Push Length[1], ft (m)
12 (300)	1,500 (6.7)	400 (121)
15 (375)	2,000 (8.9)	400 (121)
18 (450)	3,000 (13.3)	400 (121)
24 (600)	4,500 (20.0)	400 (121)
30 (750)	4,500 (20.0)	400 (121)
36 (900)	9,000 (40.0)	300 (91)
42 (1050)	11,000 (48.9)	300 (91)
48 (1200)	12,000 (53.4)	300 (91)
60 (1500)	16,000 (71.2)	300 (91)

NOTES:
Push length is provided as general design guidance. Allowable push lengths should be calculated based on the project's installation conditions using the maximum thrust force values listed in this table. The push length values shown account for weight of HP pipe and a casing pipe w/ blocking resulting in a coefficient of static friction=0.7. Conditions or design values that vary from these assumptions will impact the actual thrust force on the joint and therefore the allowable push length.

Unlike some other pipe products where even short push lengths can cause over-homing, SaniTite HP does not require special joint blocks to be fabricated; however, joint restraints may aid in protecting the joint only when the joint thrust force may be high and longer installations are anticipated.

If maximum insertion forces are being exceeded, it is important to adjust the construction technique so as to not damage the carrier pipe. One solution is instead of joining adjacent pipes outside of the casing and pushing one long section, multiple, shorter sections are homed within the casing at the final location so as to avoid pushing the entire section of pipe. This technique can also be utilized when pulling sections into the casing as illustrated in Figure 3. It is important to note that access to the carrier pipe during joint assembly inside the casing is imperative for proper joint alignment.

Figure 3
Alterative Installation Method
(Used when maximum insertion forces are likely to be exceeded)



Casing Spacers and Skids

Skids may be attached to the carrier pipe to provide a sliding surface between the casing and the carrier pipe. It is important that the skids be notched where the straps are to provide a smooth sliding surface. Typically 2 to 4 skids are placed around the pipe. These skids run the length of the pipe, however should not be located in the spigot portion of the pipe as this may affect joint assembly. Wood blocks should never be wedged between the carrier pipe and the casing pipe.

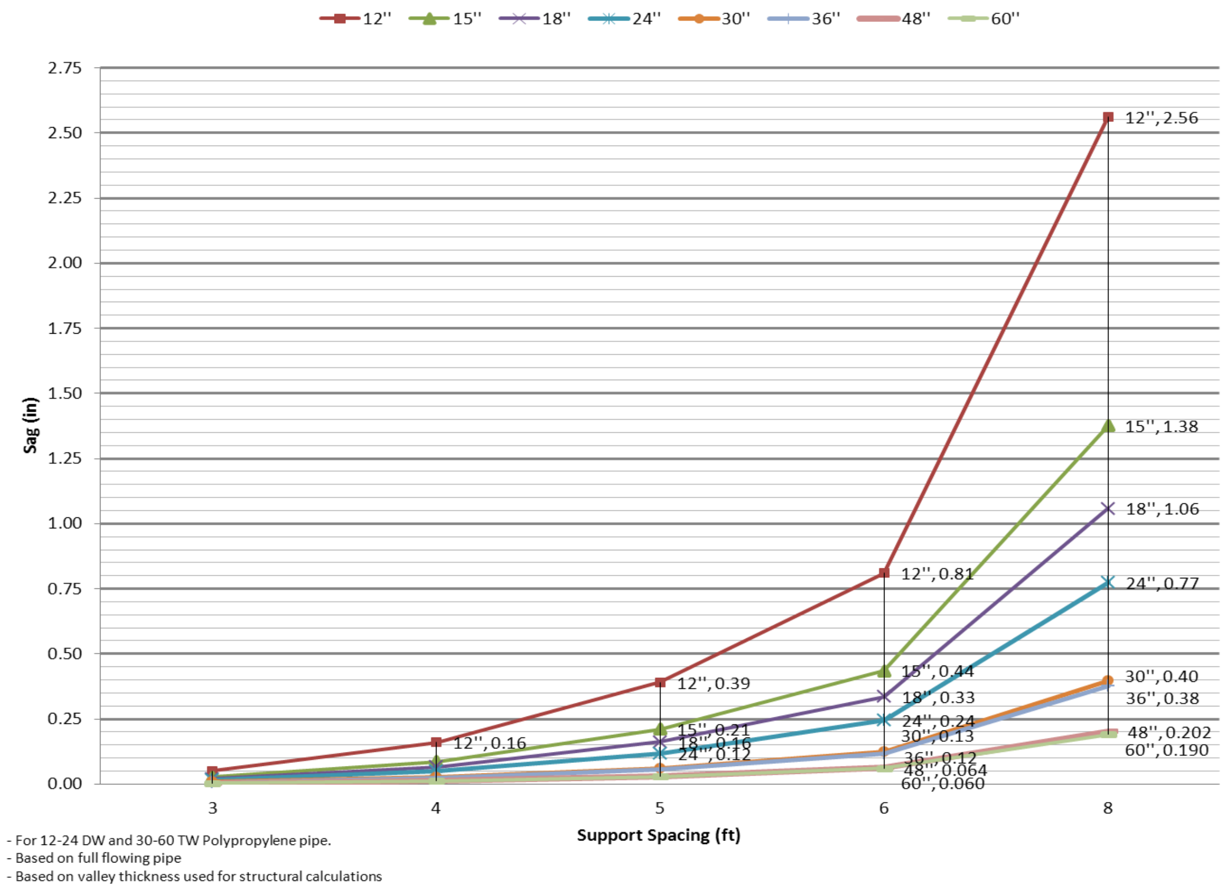
Commercially available casing spacers may also be used to slide and guide the carrier pipe into the casing. When using dual wall sanitary pipe it is important that spacers be chosen that span at least two corrugations. Small sections of lumber may be used under the spacer to act as a bridge for the spacer to set on. Casing spacers are typically manufactured from polyethylene or a combination of stainless steel with polyethylene runners, but other non-corrodible materials are available. The benefits of using manufactured casing spacers include ease of installation with no banding tools needed, a lower coefficient of friction and ability to glide over rough spots or welded joints that may otherwise cause binding.

The casing spacer manufacturer should be contacted for exact sizing availabilities, but in general, molded plastic spacers provide shorter runner heights compared to stainless steel configurations. Other considerations including pipe diameter and weight will impact casing spacer selection. Because of the lightweight of SaniTite HP, molded plastic casing spacers can often withstand the weight expected from pipe and effluent in the system. Some casing spacer manufacturers are:

RACI (www.racispacers.com),
Cascade Waterworks Manufacturing (www.cascademfg.com),
Pipeline Seal & Insulator, Inc (www.pipelineseal.com), and
Advance Products & Systems, Inc. (www.apsonline.com)

Spacing between spacers or skids is a function of the long term unsupported settlement of flexible pipe. Commonly in sanitary sewer, hydraulics and prevention of depressions in the line are the primary considerations for determining an allowable grade deviation, not necessarily product deflection limitations. As a general guideline and as specified in some regions, the pipe grade should vary no more than 0.25-in from true grade. Based on this requirement, maximum unsupported distances for SaniTite HP 30”-60” pipe is 7ft and for 12”-24” pipe is 4ft. This recommendation is based on the conservative assumption that the sewer line will be flowing full for the duration of its service life. For cases where a specific settlement allowance exists or more accuracy is desired, Chart 1 below provides anticipated long-term settlement of the pipe under full-flow conditions based on spacer distance. If the necessary spacing cannot be achieved or is not practical, other methods to support the pipe invert may be used, including the use of skids in between supports or filling the void space with soil or grout material, at the discretion of the design engineer. Alternative design assumptions, such as lower flow capacities, will impact the anticipated settlement of the pipe and maximum unsupported length of pipe.

Chart 1
Unsupported Deflection of SaniTite HP



Closure After Pipe Installation

Any post-installation testing required for the sewer pipe should be successfully completed before any backfilling or closure operations begin.

Filling the void space between the carrier pipe and the casing pipe shall be done at the discretion of the engineer. In some cases, fill material may cause the load to be distributed to the carrier pipe and affect performance if not initially accounted for in structural design. Partial fill that supports the bottom ¼ of the pipe may sometimes be used if the invert of the pipe must be fully supported to ensure long-term grade elevation. Grout material, often a controlled low strength material (CLSM), also referred to as controlled density fill, CDF, or flowable fill is commonly utilized, with blown sand and gravel being other materials used to fill the void space as desired. CLSM will help provide uniform support on the sides of the pipe, maintain a consistent soil density, provide lateral support for the pipe, and eliminate point loads. For more information on flowable fill mix, refer to Technical Note 5.02: *Flowable Fill Backfill for Thermoplastic Pipe*. It is critical measures be taken to prevent flotation to maintain adequate line and grade of the carrier pipe. Grouting in layers thin enough, such that they don’t float the pipe, helps tremendously.

Each layer should be allowed to set up between pours. Contractors may have other techniques that will also prevent flotation such as the use of deadweight inside the pipe. Regardless of the method used, it is also important to avoid applying point loads to the pipe. For more information on flotation and anchoring methods, refer to Technical Note 5.05: *Pipe Flotation*.

When SaniTite HP pipe, or any flexible pipe, is used as a liner, it is very important not to use excessive grout pressure. In most circumstances, the joint, not the wall strength, will be the limiting factor for establishing a maximum allowable grouting pressure. Including a factor of safety, the recommended maximum grouting pressure for HP pipe products is 5 psi; this value may vary based on specific site conditions and specific products used. During the grouting operation, gauges should be used to monitor the grout pressure exerted on the pipe system. For some applications, hydrostatic head pressure may increase the expected pressure on the pipe from the grouting. Additional pressure may also result from the slope and/or diameter of the pipe, elevation changes between the pipe and the gauge, and other conditions that should be considered during the design. The sum of all pressures that will be exerted on the pipe should not exceed the recommended maximum pressure for the application.

Once the carrier pipe has been successfully placed and tested within the casing pipe and any backfilling procedures are complete, the ends of the casing are typically sealed to prevent infiltration. Bricks, grout or manufactured rubber end seals are typical methods for sealing the ends of the casing pipe. For installations where a high hydrostatic load is anticipated, a watertight seal, such as a rubber boot, may be necessary to protect the carrier pipe.